



*Environmental Engineering, Civil Engineering
Forensic Engineering, Construction Services*

REVISED SAMPLING AND ANALYSIS PLAN

**Elliott Landing
201 Elliott Street
Beverly, MA 01915**

Prepared for:

Cummings Properties, LLC
200 West Cummings Park
Woburn, MA 01801

Prepared by:

FSL Associates, Inc.
358 Chestnut Hill Avenue
Boston, MA 02135

April 4, 2017

TABLE OF CONTENTS

1.0	INTRODUCTION.....	1
1.1	SAMPLING PURPOSE AND OBJECTIVES	1
1.2	PROJECT ORGANIZATION.....	1
1.3	STATEMENT OF SPECIFIC PROBLEM.....	1
2.0	BACKGROUND INFORMATION	2
2.1	OVERALL USM SITE BACKGROUND	2
2.2	ELLIOTT LANDING PARCEL BACKGROUND.....	5
2.3	PREVIOUS SAMPLING DATA AT THE ELLIOTT LANDING PARCEL	5
3.0	PROJECT DATA QUALITY OBJECTIVES.....	6
3.1	DATA QUALITY OBJECTIVES	7
3.2	DATA QUALITY INDICATORS.....	7
3.3	DATA REVIEW AND VALIDATION	8
3.4	DATA MANAGEMENT	8
4.0	SAMPLING AND SAMPLING RATIONALE.....	9
4.1	SOIL VAPOR SAMPLING.....	9
4.2	GROUNDWATER MONITORING WELL INSTALLATION AND SAMPLING	11
5.0	GENERALLY APPLICABLE PROCEDURES AND PROTOCOLS	15
5.1	LABORATORY ANALYSES.....	15
5.2	FIELD METHODS AND PROCEDURES	16
5.3	FIELD SCREENING	17
5.4	DECONTAMINATION PROCEDURES	18
5.5	SAMPLE CONTAINERS, PRESERVATION, AND STORAGE	18
5.6	DISPOSAL OF INVESTIGATION-DERIVED WASTE AND OTHER MATERIALS	19
5.7	SAMPLE DOCUMENTATION AND SHIPMENT	19
6.0	QUALITY CONTROL.....	22
6.1	FIELD QUALITY CONTROL SAMPLES	22
7.0	FIELD VARIANCE.....	23
8.0	SAMPLING SCHEDULE	23

APPENDICES

Figures

Figure 1 – Locus Plan

Figure 2 – Former United Shoe Machinery North Parcel Site Plan

Figure 3 – Approximate Locations of Soil Remediation Areas

Figure 4 – Historic Locations of Previous Soil and Groundwater Samples (1987-2008)

Figure 5 – Proposed Locations of Soil Gas and Groundwater Well Sampling Points

Tables

Table 1 – Summary of Historic Soil Analytical Results

Table 2 – Summary of Historic Groundwater Analytical Results

Table 3 – Data Quality Objectives

1.0 INTRODUCTION

This Sampling and Analysis Plan (SAP) was prepared in order to detail the sampling activities associated with the Elliott Landing parcel (Locus) within the former United Shoe Machinery (USM) Division North Parcel at 201 Elliott Street in Beverly, Massachusetts.

1.1 Sampling Purpose and Objectives

The objectives of this SAP are provided below:

1. Characterization of soil vapor samples for purposes of determination for the presence of possible vapor intrusion. Procedures for soil vapor sampling are described in Section 4.1 of this plan.
2. Characterization of groundwater collected from planned groundwater wells adjacent to the Elliott Landing building. Procedures for the sampling and analysis of groundwater are described in Section 4.2 of this plan.
3. To enable the United States Environmental Protection Agency (USEPA) to assess and evaluate the procedures implemented during the sampling at the Locus, as well as to ensure that the sampling meets agency requirements.

1.2 Project Organization

The project team organization for this SAP is described below. FSL's Project Coordinator will be responsible for coordinating communications with all parties participating in the planned sampling activities.

FSL's Project Manager will be responsible for communicating and coordinating planned activities at the Locus, and to ensure that adequate resources are allocated to the project to complete the sampling activities as planned.

FSL's SAP Quality Assurance (QA) Officer will be responsible for overseeing all sampling activities and will ensure that samples are collected according to established protocols described herein.

1.3 Statement of Specific Problem

The SAP is being prepared in order to describe the field and laboratory procedures used during the collection and analyses of soil vapor and groundwater samples at the Locus.

Based upon review of the USM Site history and consideration of the residential use of the Locus, the primary question to be addressed by this investigation is whether potential petroleum and/or volatile contaminant concentrations present a potential indoor air risk from vapor intrusion to occupants at

the building at the Locus. The purpose of the confirmation sampling described herein is to identify if volatile and/or petroleum compounds are present at the Locus and, if such compounds are present, if their concentrations represent a significant risk (as defined by the Massachusetts Contingency Plan [MCP]) to residential use of the Elliott Landing building. If sampling shows that no threshold criteria are exceeded, then actions will be deemed suitably completed. Otherwise site-specific risk calculation based on residential use will be performed to determine the total level of risk due to potential vapor intrusion. Additional sampling may also be performed.

2.0 BACKGROUND INFORMATION

Background information for both the former USM facility and the Locus are presented below.

2.1 Overall USM Site Background

The former USM Division North Parcel consists of approximately 80 acres at 181 Elliott Street in Beverly, Massachusetts. A Locus Plan is shown as **Figure 1** and a Site Plan as **Figure 2**. As shown in Figure 2, Elliott Landing is located on a separate parcel (201 Elliott Street) on the extreme southwest portion of what was formerly the USM site, just south of the West Parking Garage.

The facility operated as USM from 1905 to 1987 and was used primarily to produce shoe manufacturing machinery. On-site operations involved metal casting, forming, and machining. Various petroleum products, solvents, and paints were historically used. Support activities for manufacturing operations included burning of coal and fuel oil for power generation, recirculation of water from the Lower Shoe Pond for powerhouse cooling, pumping of water from the Upper Shoe Pond for nonpotable purposes, and construction of cinder track beds for rail transport. Pond sediments from both ponds were periodically dredged and placed as fill on-site in the former ball field area.

The USM business was purchased by Emhart Corporation (Emhart) in 1976. In 1987, Emhart sold the shoe machinery business to Ablekind Ltd. of Great Britain, which moved equipment from the facility while Emhart retained the property. Property use between 1987 and 1996 was for storage and light industry by a number of tenants. The property was sold to Beverly Commerce Park, Inc. in 1996, which redeveloped the site into the current Cummings Center. Current uses of the site include office, retail, and commercial use.

Cummings Center (the former USM Machinery Division North Parcel) is a subset of the entire property that was the former USM Machinery Division. There is also a South Parcel of the former USM Machinery Division which is located on the south side of Elliott Street (Route 62). Environmental response actions at the former USM Machinery Division property have been performed under the requirements of the Massachusetts Contingency Plan (MCP), 310 CMR 40.0000. The property was reported to the Massachusetts Department of Environmental Protection (MADEP) in 1989. Extensive

environmental site characterization occurred at the property from 1987 to 1990 with samples collected throughout the property primarily relating to soil and groundwater. Samples of surface water and sediment at the Upper and Lower Shoe Ponds (located on the property) were also taken. Samples were analyzed for total petroleum hydrocarbons (TPH), volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), and metals. Sampling strategies and results are documented in “Phase II – Comprehensive Site Assessment, United Shoe Machinery Facility, Beverly, Massachusetts” by Haley & Aldrich, Inc., June 1991. As described in the Phase II report, soil samples from across the facility contained detectable levels of metals, VOCs, SVOCs, and TPH. PCBs were detected in only a limited number of soil samples and typically at concentrations less than 1 part per million (ppm), although elevated PCB concentrations were detected in some of the excavated soil stockpiles. The majority of groundwater samples from across the site did not contain VOCs, PCBs, or SVOCs, but did typically contain some metals and TPH at low concentrations.

The Phase II report references a separate human health risk characterization report (“Phase II Risk Characterization for the USM Site” by Cambridge Environmental Inc., June 1991). Results of the risk characterization indicated that, for most of the USM facility, risk estimates were below the MCP risk criteria. The risk characterization was performed using an unrestricted use scenario (i.e., residential use), and identified possible future risk at five property locations under this scenario. These five locations (as shown in **Figure 3**) were as follows:

- Chip Grind Shed Area – Primary contaminants of concern identified as TPH and PCBs
- Chip Storage Shed Area – Primary contaminants of concern identified as TPH and PCBs
- Area 2.8 – Primary contaminants of concern identified as TPH and naphthalene
- West Parking Lot “Hot Spot” – Primary contaminant of concern identified as lead
- Ball Field “Hot Spot” – Primary contaminant of concern identified as TPH

None of these areas included the Locus. SVOCs in soil were the primary contaminants contributing to the risk.

A Phase III Final Remedy Response Plan was completed in August 1992 by Haley & Aldrich. As future property development plans were for commercial use and did not at that time include residential use, the Phase III report developed a remedial plan based on a restricted commercial use scenario. Under this scenario, soil remediation by excavation and on-site cold-mix batching or off-site disposal was selected as the remedial alternative. Soil remediation took place at the locations identified above. No groundwater remediation was included in the remedial plan as the groundwater was not used for drinking water purposes.

In April 1996, an Activity and Use Limitation (AUL) was placed on the entire Northern Parcel property to prohibit future residential site use and to limit site use to commercial and industrial uses. As part of the AUL, use of the on-site ponds was restricted to prohibit recreational uses, such as boating, swimming, and fishing.

Soil remediation occurred from October 1996 to July 1997 and is documented in the report “Phase IV Final Inspection Report” by Haley & Aldrich, October 1997. The primary locations of soil remediation are shown in **Figure 3**. The soil remediation goals were those as established by the MCP for non-residential use. These included a soil remediation goal for TPH of 10,000 ppm, a PCB goal of 2 ppm, and a goal for lead of 600 ppm. Confirmatory samples collected during soil remediation documented successful achievement of these goals. Sample results are included in the Phase IV report. No groundwater remediation was performed as it was deemed not necessary based on the MCP risk assessment protocols applicable at that time. This conclusion was based on the original 1988 Phase II sampling as well as additional groundwater sampling and analysis performed in 1995. Oil non-aqueous phase liquid (NAPL) was encountered during the soil excavation of the area known as the former Chip Grind Shed. The NAPL source was believed to have been from oil in abandoned utility lines from the adjacent Powerhouse (now known as Building 900).

After the completion of the remediation documented in the Phase IV report, the North Parcel property was closed with a Response Action Outcome (RAO) Statement (Haley & Aldrich, October 1997) in accordance with the MCP. The RAO documented that a condition of no significant risk to human health existed at the site as long as the site use remained restricted in accordance with the AUL.

Between 1997 and 2016, the AUL was amended six times to allow alternative uses at portions of the property that were originally not allowed under the AUL. These amendments included allowing the use of the interior spaces of all buildings for unrestricted use, the use of certain outdoor areas for child day care play areas, and allowing light recreational use of the land area surrounding the Upper and Lower Shoe Ponds. For each amendment, additional site assessment and/or risk characterization was performed to document that the modification or removal of certain AUL restrictions would maintain a condition of no significant risk as defined by the MCP.

As part of the 2006 and 2008 AUL amendment process (fourth and fifth amendments), soil gas testing was performed around the Cummings Center buildings to determine if the threat of vapor intrusion existed as a result of the residual contaminants that remained in the subsurface. While volatile compounds were detected in the soil gas samples, the conclusion of the risk characterizations (based on the applicable protocols at that time) was that no significant vapor intrusion was present in the buildings. This information is included in the Fourth and Fifth Amendments to the Activity and Use Limitation, which were recorded with the South Essex County District Registry of Deeds in August 2006 and September 2008, respectively. The Sixth Amendment (recorded with the South Essex County

District Registry of Deeds in June 2016) dealt specifically with the Locus, a subset of the former USM property with a separate address of 201 Elliott Street, Beverly, MA and allowed residential use of this parcel. The Sixth AUL Amendment relied on data previously collected in this area of the property for the Fifth Amendment.

In summary, the following potential contaminants of concern have been historically identified at the overall USM Site:

- (1) Volatile organic compounds (VOCs)
- (2) Semivolatile organic compounds (SVOCs)
- (3) Metals
- (4) Polychlorinated biphenyls (PCBs)
- (5) Petroleum hydrocarbons

2.2 Elliott Landing Parcel Background

Based on the 1991 Phase II report, the Locus is located within the USM Site portion identified as Sector 6. Sector 6 is located adjacent to and north of Elliott Street. This area has been vacant throughout the history of the USM Facility and was used primarily for parking. The western portion of the sector (which contains the Locus) was originally part of the former Mill Pond. Figure 3 of the 1991 Phase II report shows the former location of the Mill Pond and the current building within the Locus is within the former Mill Pond location. When the Upper and Lower Shoe Ponds were created during early site construction, much of the Mill Ponds' boundaries were realigned, but a remnant of the original Mill Pond remained in the western portion of Sector 6. The Mill Pond remnant was filled in by the 1940s and used as parking space. As such, there is no history of industrial activity at the Locus.

The building at Elliott Landing is of new construction and is used as residential condominiums.

2.3 Previous Sampling Data at the Elliott Landing Parcel

Previous soil and groundwater data exist within the Locus. Specifically, four groundwater wells and five soil boring locations were installed and sampled between December 1987 and September 1989 as part of the Phase II for the USM site. In addition, 10 soil borings were installed and sampled within the parcel as part of the 2008 data collection for the Fifth Amendment to the AUL. The locations of the historic soil and groundwater sample points are shown in **Figure 4**. In general, no significant concentrations of volatile compounds have been historically detected in soil or groundwater on the Locus.

A summary of detected compounds for the soil samples is shown in **Table 1**. The majority of compounds detected were either metals or polycyclic aromatic hydrocarbons (PAHs), neither of which

would have any potential impact on vapor intrusion. Trace concentrations of naphthalene (detected in only two samples with a maximum concentration of 0.818 mg/kg), toluene (detected in only one sample at a concentration of 0.15 mg/kg) and 1,1,1-trichloroethane (detected in only one sample at a concentration of 0.11 mg/kg) were detected but at concentrations several orders of magnitude lower than the applicable MCP Method 1 S-1 soil standards. The locations of these sample points (SB-15, SB-16, and SB-17) are to the south of the Elliott Landing building.

A summary of the detected compounds for the groundwater samples is shown in **Table 2**. Of the four groundwater wells, three of them were only sampled once (between January and June 1988). One well (LMB204) was sampled in January 1988 and September 1989. The majority of compounds detected were either metals or PAHs, neither of which would have any potential impact on vapor intrusion. Trace concentrations of naphthalene were detected at a concentration of 21 ug/L in one well (WPB302), well below the MCP Method 1 GW-2 standard of 700 ug/L related to potential vapor intrusion. Total petroleum hydrocarbons using the old infrared Method 418.1 for oil and grease were detected in four of the groundwater samples, two of which were above the Method 1 GW-2 standard. It is important to remember that Method 418.1 has long been discontinued from use due to its inaccuracy compared to current analytical methods, and the method had a long history of false positive readings. The quantitative values from these data are subject to question.

3.0 PROJECT DATA QUALITY OBJECTIVES

Data Quality Objectives (DQOs) are qualitative and quantitative statements for establishing criteria for data quality and for developing data collection designs. This section defines what the data will be used for and what qualities of data are needed to make decisions and is based on EPA's Guidance for the Data Quality Objectives Process (EPA QA/G-4, Final, September, 1994). See Table 3 for the DQOs.

The following sampling will be done for soil vapor and groundwater:

- **Soil Vapor Sampling:** Six soil gas points will be installed underneath the Elliott Landing building. Two sampling events are planned: one to take place in the winter season shortly after the installation of the new wells and one to take place in a different season of the same year during a high groundwater elevation. Sampling and analysis for each of the above described activities is further described below.
- **Groundwater Sampling:** Three new wells are planned for installation. The new wells will be developed prior to sampling. Two sampling events are planned: one to take place in the winter season shortly after the installation of the new wells and one to take place in a different season of the same year during a high groundwater elevation. Sampling and analysis for each of the above described activities is further described below.

3.1 Data Quality Objectives

An integral part of the SAP is the QA/QC program which is designed to ensure the reliability of all data generated during an investigation or remedial cleanup. During the onsite work, a variety of data will be collected. Each sample collected will be analyzed for a number of different chemicals. Data collected will be evaluated to determine whether the reported concentrations for these chemicals are of acceptable quality for use in the evaluation of whether remedial or investigative activities are meeting the Data Quality Objectives (DQOs) for this project. The QC checks discussed below will be used to verify that the collected data are not invalid or estimates as a result of inadequate or errant field or analytical procedures.

3.2 Data Quality Indicators

Data quality indicators include precision, accuracy, completeness, comparability, and representativeness established for various aspects of data gathering, sampling, or analysis activity. The analytical methods being employed are described in Section 5.1.2 and are all capable of providing the required level of analytical sensitivity, accuracy, precision, comparability and representativeness. The Data Quality indicators (DQIs) for the parameters noted in Section 3 can be found in the overall project Quality Assurance Project Plan (QAPP).

Definitions of the DQI terms are provided below:

- Precision is the degree of mutual agreement between or among independent measurements of a similar property (usually reported as a standard deviation [SD] or relative percent difference [RPD]). This indicator relates to the analysis of duplicate laboratory or field samples. An RPD of <20%, depending upon the chemical being analyzed, is generally acceptable. Typically field precision is assessed by co-located samples, field duplicates, or field splits and laboratory precision is assessed using laboratory duplicates, matrix spike duplicates, or laboratory control sample duplicates).
- Accuracy is the degree of agreement of a measurement with a known or true value. To determine accuracy, a laboratory or field value is compared to a known or true concentration. Accuracy is determined by such QC indicators as: matrix spikes, surrogate spikes, laboratory control samples (blind spikes) and performance samples.
- Representativeness is the expression of the degree to which data accurately and precisely represent a characteristic of an environmental condition or a population. It relates both to the area of interest and to the method of taking the individual sample. The idea of representativeness should be incorporated into discussions of sampling design. Representativeness is best assured by a comprehensive statistical sampling design, but it is recognized that this is usually outside the scope of most one-time events. Most one-time plans

should focus on issues related to judgmental sampling and why certain areas are included or not included and the steps being taken to avoid either false positives or false negatives.

- Completeness is expressed as percent of valid usable data actually obtained compared to the amount that was expected. Due to a variety of circumstances, sometimes either not all samples scheduled to be collected can be collected or else the data from samples cannot be used (for example, samples lost, bottles broken, instrument failures, laboratory mistakes, etc.). The minimum percent of completed analyses defined in this section depends on how much information is needed for decision making. Generally, completeness goals rise the fewer the number of samples taken per event or the more critical the data are for decision making. Goals in the 95% range are typical.
- Comparability expresses the confidence with which one dataset can be compared to another. The use of methods from EPA or "Standard Methods" or from some other recognized sources allows the data to be compared facilitating evaluation of trends or changes in a site, a river, groundwater, etc. Comparability also refers to the reporting of data in comparable units so direct comparisons are simplified.

3.3 Data Review and Validation

Field data sheets and log books will be reviewed by the FSL QA Officer on a daily basis to ensure that instrument calibrations, equipment operation, and sampling conditions have been accurately documented. Data validation will be limited to the laboratory analytical results. The data packages will be reviewed for completeness. Validation will be performed on the data but will be limited to holding times and QC results, as summarized on forms from the laboratory. Such validation actions will be in accordance with the Guidance on Environmental Data Verification and Validation (EPA QA/G-8), dated November 2002. A data review will be conducted to flag suspect samples or laboratory reported results which fall outside of acceptable reporting limits. Data which is flagged or rejected will be determined and will be appropriately noted in the final reported analytical summary tables. A memorandum summarizing the results of the validation will be included in the report. FSL will ensure that deliverables from the laboratory will be sufficient for more detailed data validation at another date, if needed.

3.4 Data Management

Field notes will be maintained to document and describe any changed conditions in the field during sample collection, sample preparation, and sample shipment. Field sketches in the project notebook will be prepared when required to describe actual conditions and locations of samples. Sample point locations will also be documented by GPS. Digital photographs may also be utilized to document field conditions observed during the time of sampling.

4.0 SAMPLING AND SAMPLING RATIONALE

This section provides a discussion and description of the sampling activities and the rationale for the sampling at the site.

4.1 Soil Vapor Sampling

Based upon review of the USM Site history and consideration of the residential use of the Locus, the primary question to be addressed by this investigation is whether potential petroleum and/or volatile contaminant concentrations from vapor intrusion present a significant risk (in accordance with the MCP) to the occupants of the building at Elliott Landing. Based on a review of the historic data in the Locus (see Section 2), there has been no history of significant presence of VOCs in the soil or groundwater. As such, it is probable that this investigation will corroborate the historical information. Typically, indoor air samples and building sub-slab soil gas samples are collected concurrently. In this case, however, there has not been a building on the Locus until the recent construction of the Elliott Landing building that is used for residential condominiums. As such, indoor air sample analysis of the new building would result in only detections of various indoor sources (new carpets, paints, etc.) Vapor intrusion would not be expected in a newly constructed building even if a VOC source were present underneath the building. Because of this, and because a VOC source underneath the building is not suspected, indoor air sampling will not be conducted. For the purposes of this specific sampling and analysis plan, air sampling will be limited to sub-slab soil gas samples collected underneath the building. If indoor air samples are to be collected based on a determination of the results of the sampling performed in this plan, details of such sampling would be included in a supplemental sampling plan.

Figure 5 depicts the proposed locations to collect the gas samples. The gas samples will be collected just beneath the floor slab. The following approach will be followed during the vapor probe installation, sampling, and analyses:

Six vapor probes will initially be installed beneath the slab of the Elliott Landing building (**Figure 5**). The soil vapor concentrations at these locations will be measured during two separate sampling efforts; one to take place in the winter season and one to take place in a different season of the same year during a high groundwater elevation. Soil gas and groundwater data will be evaluated in accordance with the MCP and the MADEP Vapor Intrusion Guidance Policy WSC#-16-435.

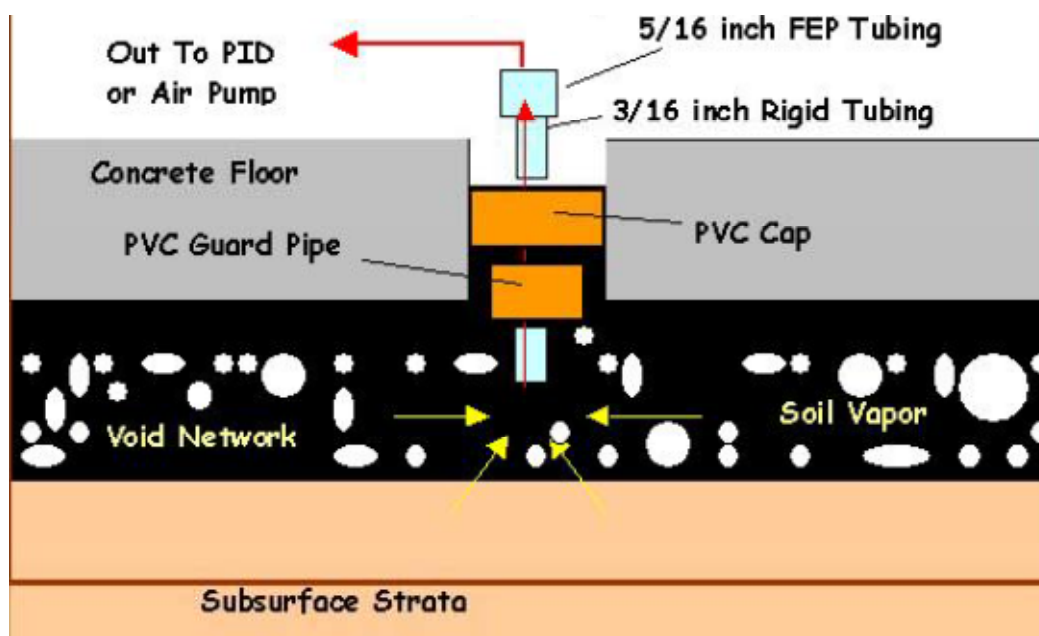
As appropriate, site-specific risk calculation based on residential use will be performed to determine the total level of risk due to potential vapor intrusion. In addition, indoor air samples may be collected at or near locations of soil gas sample points with elevated VOC and/or petroleum hydrocarbon concentrations to establish if vapor intrusion is actually occurring. If indoor air samples are to be collected, details of such sampling would be included in a supplemental sampling plan.

The following sections describe the vapor probe installation procedures and the sampling and analysis for soil vapor.

4.1.1 Vapor Probe Installation

Each sampling port is anticipated to be installed as follows: 1) a 1-inch diameter hole will be drilled to a depth of 2-3 inches and vacuumed of debris; 2) a 3/8-inch diameter hole will be drilled through the concrete slab into the sub-slab material (vapor-barrier overlying well-graded, compacted backfill); 3) a 3/8-inch outer diameter polyethylene or similar rigid plastic piping will be inserted through a rubber stopper and into the 3/8-inch drill hole approximately 2-3 inches below the bottom of the floor slab; 4) the stopper will be placed at the bottom of the 1-inch drill hole and cemented-in with expanding hydraulic cement; 5) a vinyl cap will be placed on top of the rigid piping; and 6) a 1-inch diameter rubber expansion cap will be inserted into the hole.

A generalized design is depicted in the figure below.



Example of a Soil Gas Sampling Point (from Final Vapor Intrusion Guidance October 2016, Massachusetts Department of Environmental Protection Policy WSC#-16-435)

The sampling locations depicted in **Figure 5** may have to be moved if extensive floor slab thickness and/or a shallow groundwater table results in a flooded soil gas location.

A minimum of 48 hours will be allowed before sampling the newly installed points to allow for the concrete to dry and the soil gases to equilibrate.

4.1.2 Soil Vapor Sampling

After allowing at least 48 hours for the concrete to dry and the soil gases to equilibrate, soil gas samples will be collected using 2.7-liter glass-lined “Summa” canisters. These vacuum canisters will have pre-set, 30-minute regulators to collect a soil gas sample under low-flow conditions (0.09 liters/minute) in order to prevent short-circuiting the sub-slab soil gas air flow from beneath the concrete slab. A ¼-inch diameter FEP or similar rigid plastic piping will be connected to the 3/8-inch diameter sampling port tubing via a stainless steel coupling. The tubing will be connected to a photoionization detector (PID) with a 11.8 eV lamp, and the tubing will be evacuated for approximately one minute while total VOC concentrations are recorded with the PID. The vacuum canister will be connected to the FEP tubing and the 30-minute regulator (with in-line particulate filter) will be opened and a soil gas sample will be collected, labeled, and logged. From each soil gas point, a single grab sample will be collected per individual sampling event. Each Summa canister will be labeled with the sample location identification number, sample depth, date, and time. Following the completion of sampling, all of the samples will be transported to a laboratory along with a standard chain-of-custody record.

Sample analysis for the soil gas samples will consist of the following parameters:

- Air-Phase Petroleum Hydrocarbons (APH) using MADEP methodology
- Volatile Organic Compounds (VOCs) using EPA Method TO-15

Sample analysis will be requested to be performed in the SIM mode to obtain the lowest achievable (most conservative) detection limits. In accordance with the APH analytical method, the potential identification of non-APH compounds (such as chlorinated solvents, ketones, and ethers) may represent an interference with the quantitative response within the aliphatic or aromatic hydrocarbon range. A specific request will be made for non-APH compounds to be identified in the laboratory report form or narrative, such that the data may be evaluated for such potential interference.

4.2 Groundwater Monitoring Well Installation and Sampling

4.2.1 Pre-Well Installation Activities

4.2.1.1 Drilling Notification

DIGSAFE will be notified at least 72 hours prior to initiation of drilling and sampling. All planned monitoring well locations will be clearly marked with white paint and/or flagging, as required by DIGSAFE. DIGSAFE will contact public utility owners of record within the boring vicinities and notify

them of our planned underground activities. Utility owners of record in the area, or their designated agents, will clearly mark the position of their utilities on the ground surface throughout the designated area.

4.2.1.2 Well Locations

The proposed well locations (FSL-1, FSL-2, and FSL-3) are shown on **Figure 5**. Groundwater direction is generally to the south towards the Bass River. The proposed well locations are on the north side of the Elliott Landing building (upgradient and downgradient of the Elliott Landing building - downgradient of the other USM parcel buildings [locations of the former industrial activity]). Overall local groundwater flow direction has been previously established to be south-southwest towards the tidally influenced Bass River. The proposed well locations allow for a triangulation of localized groundwater flow direction in the Locus.

4.2.2 Well Installation Activities

4.2.2.1 Drilling, Soil Sampling, and Logging

Each well boring will be drilled using a hollow stem auger drill rig equipped with a 10-inch diameter drill bit. Each well boring will be drilled to a depth of about 10 feet below the depth where groundwater is encountered or an estimated depth of about 15 feet. Soil sampling will be conducted at 5-foot intervals. After each five-foot run, the sampler will be brought to the surface. The soil will be removed from the sampler and placed on a work table for logging and lithologic description. The soil description will include a lithologic description (using the Unified Soil Classification System), color (using the Munsell color system), general moisture content, and mineral content (if visible). All soil descriptions will be recorded onto a standard boring log form. The percent sample recovery will be recorded on the boring log for sample runs that do not have 100 percent recovery. Sample recovery is defined as the length of sample recovered relative to the distance to which it was driven into the soil.

A portion of each soil sample collected at 5-foot sample intervals will be placed in a plastic re-sealable bag and allowed to volatilize. The headspace of each bag will be measured in the field for volatile organic compounds (VOCs) using a photoionization detector (PID). Depending upon the ambient outdoor air temperature, multiple samples in the 5-foot interval might be selected for headspace evaluation with the PID. Samples will be collected for VOC headspace screening based potential signs of contamination such as odor or discoloration. Headspace measurements will be recorded on the boring logs. No soil samples will be collected for laboratory analytical analysis unless obvious signs of contamination are noted.

4.2.2.2 Well Construction Details

Monitoring wells will be constructed of new 2-inch nominal ID PVC riser pipe and well screen. The well materials will be threaded, flush-joint, Schedule 40 PVC, and will conform to ASTM D1785 requirements. Well screen will provide a slot size of approximately 0.01 inches, and will allow for coupling to the riser pipe. The screened portions of the monitoring wells will typically be designed to intersect the observed water table surface (and floating product, if present). An approximately 10-foot long well screen will be placed straddling the water table to allow for seasonal fluctuations in the water table.

No solvents, glues, or grease will be used during well assembly. Wells will be constructed inside the hollow stem augers or casing. A filter sand pack will be placed in the annular space between the well and the borehole wall. The sand pack will consist of a uniformly graded and washed silica sand of coarse-, or medium- to coarse-grain sizes. Filter sand will be placed from the bottom of the well screen to an elevation approximately two feet above the top of the screen.

An approximately two-foot (or greater) thick layer of bentonite will be placed above the sand pack in the annular space between the well and the borehole wall. Potable water may be added to the bentonite after placement to hydrate and expand the bentonite prior to placement of additional filter sand or natural formation material.

Additional filter sand or natural formation material, depending on observed soil conditions, will be placed from the top of the bentonite layer to approximately two feet below the ground surface. The remainder of the annulus will be filled with sand after placement of the standpipe or roadbox.

Upon completion of the well, an expandable plug will be placed on the riser pipe to prevent the entrance of foreign material into the well. The PVC well riser pipe will be surrounded by a larger diameter steel standpipe installed approximately two to three feet above ground surface, or by a flush mounted protective roadbox. The protective roadbox will be used where it is necessary to install wells flush with the ground surface (i.e., roadways and other traffic areas). Wells protected by above-grade standpipes will be secured with keyed-alike padlocks attached to the cap. Wells completed with roadboxes will be maintained with bolted steel lids, and the riser pipes will be fitted with lockable expandable plugs, and keyed-alike padlocks.

In addition to drilling equipment (tooling) the following materials are required:

- Schedule 40 PVC riser pipe, 2-inch diameter, flush-joint threaded
- Schedule 40 PVC slotted well screen, 2-inch diameter, 0.01-inch slots, flush-joint threaded
- PVC bottom point/plug
- Locking/non-locking expansion plug

- Bentonite clay
- Filter sand (#1 is standard but different mesh may be used on a project-specific basis)
- Metal stand pipe, approximately 4-inch diameter, 5-foot length, with set-screw Royer cover
- Road box, approximately 6 to 8-inch diameter by 10-inches deep with bolted cover plate
- Padlocks
- Measuring tape
- Field notebook

4.2.2.3 Surface Completion

Each well will be completed with a flush-mounted traffic-rated well box set in concrete that is mounded approximately 0.5 to 1 inch aboveground to prevent ponding inside the well.

4.2.2.4 Well Development

After installation, the drilling crew will develop the groundwater monitoring wells with a combination of surging and bailing. A stainless steel bailer will be used to initially purge the well water to remove sediment that collected during well installation. Surging will then be done to clean the PVC slots and the sand pack. After surging, a bailer will again be used to remove any newly generated sediment. Following the last bailing, a clean pump will be placed approximately 2 feet above the bottom of the well. The well will then be pumped at a flow rate between 0.5 and 5 gallons per minute. Pumping will continue until the well water runs clear and the groundwater parameters (i.e., pH, turbidity, conductivity) stabilize.

During well development, the goal will be to obtain water until a turbidity of 5 NTU as determined by a field instrument is achieved. To allow success towards achieving this goal, the driller will be consulted for his experience and also the casing completion will be carefully done to make sure there is minimal contact with the surrounding soil. Casing centralizers will be used as practical.

4.2.3 Groundwater Sampling

Groundwater sampling will be conducted after a minimum period of one week after the completion of well development. Two groundwater sampling events will be conducted; these will coincide with the collection of soil gas samples as described in Section 4.1. Evaluation of the groundwater conditions will be done only after the completion of the second sampling event.

4.2.3.1 Water Level Measurements

Prior to sampling, the wells will be sounded for depth to water from the top of the casing. An electronic sounder accurate to the nearest ± 0.01 foot will be used to measure the depth to water.

Total well depth will also be sounded from the surveyed top of casing by lowering the weighted probe to the bottom of the well. Total well depths will be measured to the nearest 0.1 foot.

4.2.3.2 Purging and Sample Collection

The newly-established groundwater wells will be purged and sampled using low-flow sampling protocols. During purging, field parameters (pH, temperature, electrical conductivity, oxidation-reduction potential, dissolved oxygen, and turbidity) will be collected and recorded on sampling logs. Samples will be collected after the parameters have stabilized, indicating that representative formation water is entering the well. Upon completion of purging, the well water will be transferred directly from the pump's discharge line to laboratory supplied sampling containers. Water removed from the wells during purging will be temporarily containerized in either a 5-gallon bucket or a 55-gallon drum. Upon completion of sampling, this water will be transferred to a 55-gallon drum. This drum will be properly labeled and then stored in a secured location. Groundwater data reported for the collected groundwater samples will be used to profile the waste water for disposal purposes.

Sample analysis for the groundwater samples will consist of the following parameters:

- Volatile Petroleum Hydrocarbons (VPH) and Extractable Petroleum Hydrocarbons (EPH) using MADEP methodology
- Volatile Organic Compounds (VOCs) using EPA Method 8260

5.0 GENERALLY APPLICABLE PROCEDURES AND PROTOCOLS

5.1 Laboratory Analyses

5.1.1 Analytical Laboratory

The laboratory selected to perform the analyses is Alpha Analytical Inc. of Westborough, MA. The laboratory's standard operating procedures for these analyses and the laboratory Quality Assurance Manual are included in the USM Quality Assurance Project Plan (QAPP) [*Quality Assurance Project Plan, Former United Shoe Machinery Division North Parcel*, prepared by FSL Associates, Inc., April 4, 2017]. Should the laboratory change, the QA/QC program and SOPs from the laboratory for the methods to be performed will be provided.

5.1.2 Chemical Analyses

The analytical parameters for laboratory analysis include the following analyses:

Soil Vapor

- VOCs via EPA Method TO-15
- APH via MADEP methodology

Groundwater

- VOCs via EPA Method 8260B
- VPH/EPH via MADEP methodology

Normal sample turnaround time is anticipated for the sample analysis. There are no specific QC requirements or modified sample preparation techniques required by this SAP. The analysis requested will follow the EPA and MADEP analytical methods for the parameters requested.

5.2 Field Methods and Procedures

The field methods to be employed involve the collection of groundwater and soil vapor samples. This sampling is described in Section 4. Field sampling personnel involved in sampling must wear clean, disposable gloves of the appropriate type.

5.2.1 Field Equipment

Below is a list of the materials and equipment needed for sampling activities. Both disposable and reusable sampling equipment may be required:

- Low-flow sampling pump
- Flexible tubing
- Decontamination supplies (see Section 5.4)
- Glass sample containers with lids
- Sample log sheets
- Sample labels/tags
- Coolers
- Ice
- 1-gallon and 1-quart Ziploc bags and other sizes as necessary
- Paper towels
- Ballpoint pen and permanent marker
- Plastic (disposable) trowels
- Steel trowels
- Plastic trash bags
- 5-gallon bucket or 55-gallon drum(s) as applicable

5.2.2 Calibration of Field Equipment

Field equipment, such as PID and water parameter meters, shall be calibrated prior to use according to manufacturer's instructions and recommendations.

5.3 Field Screening

During well installation, screening of soil samples for VOCs will be performed using a 11.8 eV PID calibrated to a 100-ppm isobutylene standard. The general field soil sampling and screening procedures when using PID instrument in the field will be as follows:

Use either half-filled glass jar or Ziploc® baggie.

1. When using glass jars:

- (a) fill jars with a total capacity of 8 oz. or 16 oz. to about one half of its volume; and
- (b) seal each jar with one (1) or two (2) sheets of aluminum foil with the screw cap applied to secure the foil.

2. When using Ziploc® baggies:

- (a) half fill the bag with soil, and
- (b) zip to close.

3. Vigorously shake the sample jars or bags for at least thirty (30) seconds once or twice in a 10 to 15 minute period to allow for headspace development.

4. If ambient temperatures are below 32° Fahrenheit headspace development is to be within a heated vehicle or building.

5. Quickly insert the PID sampling probe through the aluminum foil. If plastic bags are used, unzip the corner of the bag approximately one to two inches and insert the probe or insert the probe through the plastic. Record the maximum meter response (should be within the first 2-5 seconds). Erratic responses should be discounted as a result of high organic vapor concentrations or conditions of elevated headspace moisture.

6. Record headspace screening data from both jars and/or bags for comparison.

7. Calibration must be checked/adjusted daily. In addition, all manufacturers' requirements for instrument calibration must be followed.

8. If sample jars are to be re-used in the field, jars must be cleaned according to field decontamination procedures for cleaning of jars. In addition, headspace readings must be taken to ensure no residual organic vapors exist in the cleaned sample jars. Plastic bags may not be re-used.

9. Any deviation(s) from these procedures must be noted and a basis stated for the deviation(s).

5.4 Decontamination Procedures

Decontamination of sampling equipment must be conducted consistently as to assure the quality of samples collected. All equipment that comes into contact with potentially contaminated soil or water will be decontaminated. Disposable equipment intended for onetime use will not be decontaminated, but will be packaged for appropriate disposal.

Decontamination will occur prior to and after each use of a piece of equipment. All sampling devices used, including trowels and augers, will be steam-cleaned or decontaminated according to EPA recommended procedures. The following, to be carried out in sequence, is in general accordance with the EPA recommended procedure for the decontamination of sampling equipment:

- Non-phosphate detergent and tap water wash, using a brush if necessary
- Tap-water rinse
- De-ionized/distilled water rinse

Equipment will be decontaminated in a pre-designated area on pallets or plastic sheeting, and clean bulky equipment will be stored on plastic sheeting in uncontaminated areas.

Cleaned small equipment will be stored in plastic bags. Materials to be stored more than a few hours will also be covered.

5.5 Sample Containers, Preservation, and Storage

Sample container, preservation, and storage requirements for the identified analytical parameters are provided below.

5.5.1 Soil Vapor Samples

Soil vapor samples for VOCs and petroleum hydrocarbons will be collected in 2.7-liter Summa canisters and sent to the laboratory after collection. These samples will be analyzed using EPA Method TO-15 and MADEP APH method. The holding time for these samples is 14 days (based on EPA Method TO-15; APH has a holding time of 30 days). Section 4.2 provides soil vapor sampling procedures to be followed in the field.

5.5.2 Groundwater Samples

Groundwater samples for VOC (EPA Method 8260B) analyses will be collected in two 40-milliliter vials. These samples have a 14 day holding time. Groundwater samples for VPH analyses will be collected in two 40-milliliter vials. These samples have a 14 day holding time. Groundwater samples for EPH analyses will be collected in two 1-liter amber glass bottles. These samples have a 14 day holding time. Section 4 provides details on the sampling procedure from groundwater monitoring wells.

5.6 Disposal of Investigation-Derived Waste and Other Materials

The following wastes will be generated as part of the planned activities:

- Investigation-derived waste (IDW) including waste water from well development and groundwater sampling and soil cuttings from the drilling of additional monitoring wells
- Materials and disposable equipment used during the operations

Based on prior historical analysis on the Locus (see Section 2), none of the previous sampling locations contained EPA hazardous waste. Disposal of the IDW will be disposed of according to state and federal requirements. Used PPE and disposable equipment will be double bagged and placed in a municipal refuse dumpster. These wastes are not considered hazardous and can be sent to a municipal landfill. Any PPE and disposable equipment that is to be disposed of which can still be reused will be rendered inoperable before disposal in the refuse dumpster.

5.7 Sample Documentation and Shipment

This section discusses the sample documentation and shipment requirements for the sampling program.

5.7.1 Field Notes

Field notes will be recorded in the field logbooks. Field logbooks will be maintained throughout the entire sampling program. General entries made in the field logbook will include the following information: Date; Time of Day; Location onsite; Weather Conditions (Clear, Overcast, Windy, Sunny, etc.); Wind Direction and Estimated Velocity (e.g., SE@ 10 mph); Temperature (°F); Description of Observed Site Condition (s); Name of Field Personnel and their Signatures.

Specific entries will be made for each day of sampling and will record the following information in the field logbook: team members participating in the sampling; time of arrival/entry on site and time of site departure; other personnel on site; summary of any meetings or discussions with tribal, contractor, or states/federal agency personnel; deviations from sampling plans, site safety plans, and

SAP procedures; changes in personnel and responsibilities with reasons for the changes; levels of safety protection; and calibration readings for equipment.

5.7.2 Photographs

Photographs will be taken during sample collection, and to document field conditions which change. Photographs will also be taken at the sampling locations and at other areas of interest onsite. They will serve to verify information entered in the field logbook. For each photograph taken, the following information will be written in the logbook or recorded in a separate field photography log: Time, date, location, and weather conditions; Description of the subject photographed, and Name of person taking the photograph.

5.7.3 Sample Labeling

Air Canister Samples

Upon sample collection, each sample container is affixed with an identification label that contains the following information, at a minimum:

- project name & number
- field sample identification number
- canister identification number
- pre-sampling and post-sampling canister pressure
- start and end date and time of sample collection
- analysis required
- sampler's name (initials)

Groundwater Samples

Upon sample collection, each sample container is affixed with an identification label that contains the following information, at a minimum:

- project name & number
- field sample identification number
- date and time of sample collection
- analysis required
- preservative
- sampler's name (initials)

Sample containers will be labeled, using an indelible ink marker, with sample identification, date, and time at the time a sample is actually collected to prevent accidental mix-up of samples that may occur when containers are pre-labeled prior to a sampling event. Other information (project name and number, analysis type, preservation type, and sampler's name) may be completed on the sample label prior to sample collection. Samples will be identified using the numbering system shown in **Figure 5**.

5.7.4 Chain of Custody Record

All sample shipments for analyses will be accompanied by a chain-of-custody record. The chain of custodies will be completed and sent with the samples for each laboratory and each shipment. The chain-of-custody forms will identify the contents of each shipment and maintain the custodial integrity of the samples.

Generally, a sample is considered to be in someone's custody if it is either in someone's physical possession, in someone's view, locked up, or kept in a secured area. Until the samples are shipped, the custody of the samples will be the responsibility of the FSL field team conducting the sampling. The sampler or his designee will sign the chain-of-custody form in the "relinquished by" box and note date, time, and air bill number. The sample numbers for all field samples, field QC samples, and duplicates will be documented on the chain of custody. A self-adhesive custody seal will be placed across the lid of each groundwater sample.

5.7.5 Packaging and Shipment

All sample containers will be placed in a strong-outside shipping container (such as a picnic cooler). The sample packaging procedures that will be followed for the samples are described below.

1. When ice is used, pack it in zip-locked, double plastic bags. Seal the drain plug of the cooler with fiberglass tape to prevent melting ice from leaking out of the cooler.
2. The bottom of the cooler should be lined with bubble wrap to prevent breakage during shipment.
3. Check screw caps for tightness and, if not full, mark the sample volume level of liquid samples on the outside of the sample bottles with indelible ink.
4. Secure bottle/container tops with custody seals.
5. Affix sample labels onto the containers with clear tape.
6. Wrap all glass sample containers in bubble wrap to prevent breakage.
7. Seal all sample containers in heavy duty plastic zip-lock bags.

8. Place samples in a sturdy cooler(s) lined with a large plastic trash bag. Enclose the appropriate COC(s) in a zip- lock plastic bag affixed to the underside of the cooler lid.
9. Fill empty space in the cooler with bubble wrap or Styrofoam peanuts to prevent movement and breakage during shipment.
10. Ice used to cool samples will be double sealed in two zip lock plastic bags and placed on top and around the samples to chill them to the correct temperature.
11. Samples will be returned to the FSL office. Groundwater samples will be placed inside a refrigerator to maintain the required sample temperature. Air canisters do not require temperature control and will remain inside the shipping container. FSL will contact the laboratory for a courier pickup of the samples. The laboratory courier will transport the samples from the FSL office to the laboratory. A copy of the signed chain of custody form(s) will be given to FSL at the time of courier pickup.

6.0 QUALITY CONTROL

This section discusses the quality control samples incorporated into the sampling program.

6.1 Field Quality Control Samples

Field duplicates and field blanks have been incorporated into the field sampling program for each individual analytical parameter.

6.1.1 Equipment Blanks

Equipment blanks will not be collected for groundwater samples due to the limited number of individual field samples (two) to be collected at each sampling event.

6.1.2 Trip Blanks

Trip blanks will be included for all groundwater VOC sample shipments to evaluate the bias of results associated with possible cross-contamination during sample shipment.

6.1.3 Field Duplicates

Field duplicates (confirmation soil vapor samples and groundwater samples) will be collected as part of the sampling program at a rate of 10 percent to measure precision which is a measure of the mutual agreement among individual measurements of the same property. For each sampling event, one soil gas and one groundwater field duplicate will be collected.

6.1.4 Temperature Blanks

One temperature blank will be included in each groundwater sample cooler. Temperatures will be verified prior to sample shipment and upon receipt at the analyzing laboratory.

7.0 FIELD VARIANCE

Changes in field conditions on the actual day of sampling or conditions different from that expected will be documented in the field log book along with digital photographs to document the noted field variances when appropriate. If conditions make it necessary to modify the SAP the FSL QA Officer will be notified of the proposed changes and approve such changes prior to implementation in the field.

8.0 SAMPLING SCHEDULE

The proposed schedule is as follows:

- Soil vapor point and groundwater well installation/well development – April 2017
- First round of soil vapor and groundwater sample collection –April 2017
- Second round of soil vapor and groundwater sample collection – June/July 2017

FIGURES

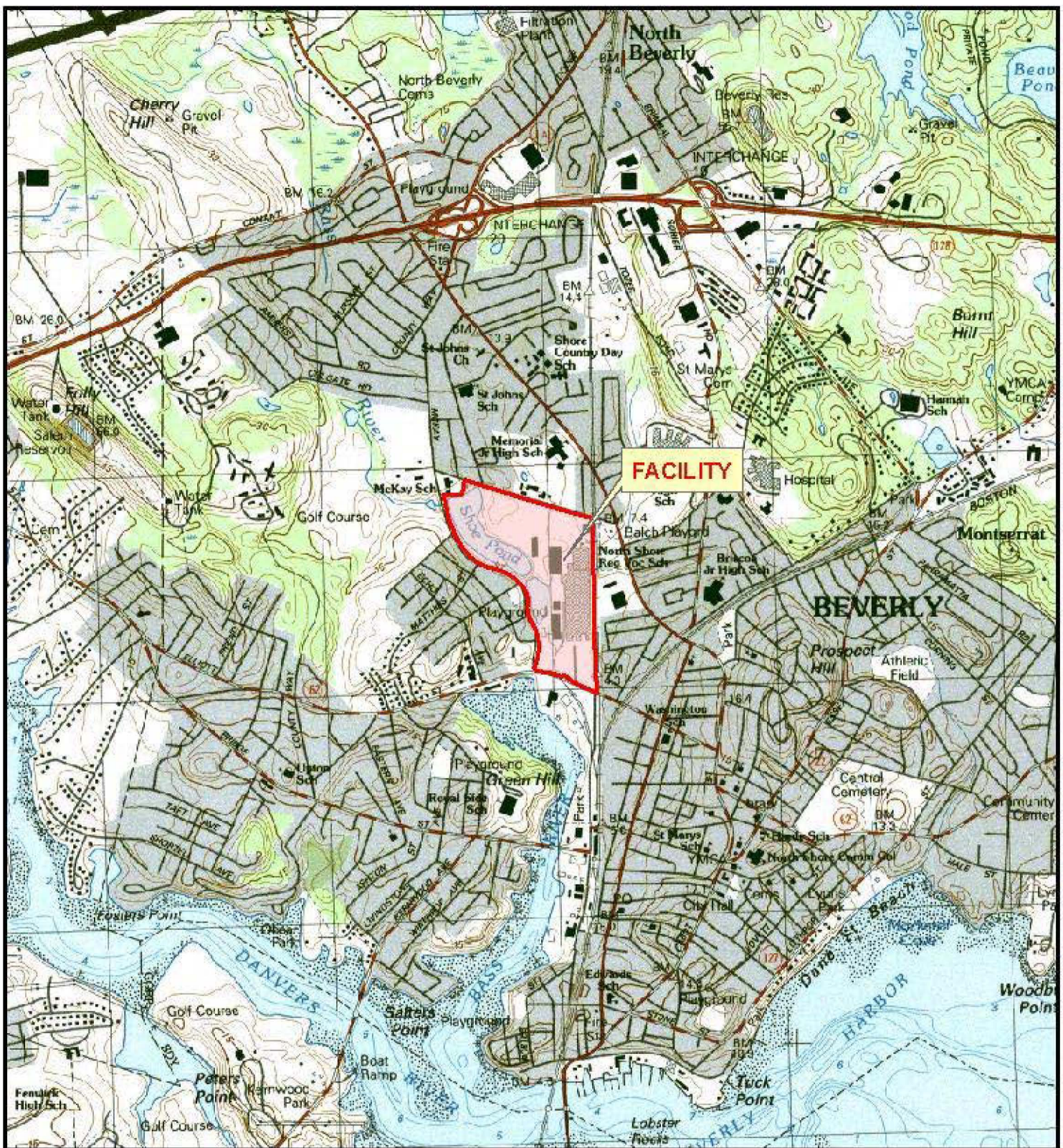
Figure 1 – Locus Plan

Figure 2 – Former United Shoe Machinery North Parcel Site Plan

Figure 3 – Approximate Locations of Soil Remediation Areas

Figure 4 – Historic Locations of Previous Soil and Groundwater Samples (1987-2008)

Figure 5 – Proposed Locations of Soil Gas and Groundwater Well Sampling Points



SITE COORDINATES
 Longitude: -70.8871 W
 Latitude: 42.5596 N
 UTM 4,713,634m N
 345,086m E



Approximate Scale: 1 inch = 2,000 feet (1:24,000)

Figure 1 - Locus Plan

Project Number: 12201
Client: Cummings

Created By: EAF **Date:** 03/15/12
Checked By: BH **Date:** 03/15/12

Former United Shoe Machinery North Parcel
181 Elliott Street
Beverly, MA

Reference: MassGIS USGS Quadrangle: SALEM and MARBLEHEAD NORTH
 Image: M12201_Beverly/2012/Figures

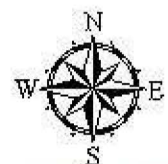
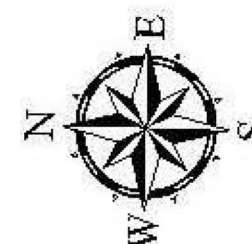


Figure 3
Approximate Locations of
Soil Remediation Areas

Former United Shoe
 Machinery North Parcel
 181 Elliott Street
 Beverly, MA

LEGEND

-  SOIL REMEDIATION AREA
-  BUILDING



0 100 200 400 feet
 Approximate Scale: 1 inch = 200 feet



Reference: MassGIS 2008 15CM Orthophotos
 Image: M\12201_Beverly\2012\Figures



TABLES

Table 1 – Summary of Historic Soil Analytical Results

Table 2 – Summary of Historic Groundwater Analytical Results

Table 3 – Data Quality Objectives

Table 1. Summary of Historical Soil Analytical Results
 Elliott Landing
 Cummings Center, Beverly, MA

Sample Identification	MCP Method 1 Soil Standards				WPTP303	WPTP304	WPTP305	WPTP306	LMB-204	SB-8	SB-9	SB-10	SB-11	SB-12	SB-13	SB-14	SB-15	SB-16	SB-17
	Depth Sample Date Units	S1/GW-2	S1/GW-3	S-2/GW-2	S-2/GW-3	0.0-9.0' 5/20/88	5.5-6.5' 5/20/88	6.0-6.5' 5/19/88	3.0-3.5' 5/20/88	6.0-8.0' 12/4/87	1.5-3' 2/11/08	1.5-3' 2/11/08	1.5-3' 2/11/08	1.5-3' 2/11/08	1.5-3' 2/11/08	1.5-3' 2/11/08	1.5-3' 2/11/08	1.5-3' 2/11/08	1.5-3' 02/11/08
		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EPH/PAH																			
C19-C36 Aliphatics	3,000	3,000	5,000	5,000	NA	NA	NA	NA	NA	23.9	97.8	<69.4	<8.13	<7.94	56.4	63.1	40.5	38.7	37.7
C11-C22 Aromatics	1,000	1,000	3,000	3,000	NA	NA	NA	NA	NA	30.7	100	319	10.7	<7.94	30.1	59.3	32.3	71.5	29.9
2-Methylnaphthalene	80	300	80	500	0.93	<0.33	6.7	<0.33	<0.33	<0.388	<1.98	<3.47	<0.406	<0.397	<0.388	<0.379	<0.374	<0.37	<0.379
Acenaphthene	1,000	1,000	3,000	3,000	<0.33	<0.33	<0.33	<0.33	<0.33	<0.388	<1.98	<3.47	<0.406	<0.397	<0.388	<0.379	<0.374	0.93	<0.379
Fluorene	1,000	1,000	3,000	3,000	<0.33	<0.33	<0.33	<0.33	<0.33	<0.388	<1.98	<3.47	<0.406	<0.397	<0.388	<0.379	<0.374	0.738	<0.379
Phenanthrene	500	500	1,000	1,000	0.47	<0.33	1.1	<0.33	<0.33	0.42	2.72	11.7	<4.06	<0.397	<0.388	0.9	0.378	7.23	1.44
Anthracene	1,000	1,000	3,000	3,000	<0.33	<0.33	<0.33	<0.33	<0.33	<0.388	<1.98	<3.47	<4.06	<0.397	<0.388	<0.379	<0.374	1.86	<0.379
Fluoranthene	1,000	1,000	3,000	3,000	1.1	<0.33	2.8	1.1	<0.33	0.658	5.74	28	<4.06	<0.397	<0.388	1.3	0.584	6.61	1.54
Pyrene	1,000	1,000	3,000	3,000	0.73	<0.33	2.5	0.75	<0.33	0.584	4.86	24.5	<4.06	<0.397	<0.388	0.99	0.527	5.41	1.04
Benzo(a)anthracene	7	7	40	40	<0.33	<0.33	1.8	<0.33	<0.33	<0.388	3.52	19.6	<4.06	<0.397	<0.388	0.505	<0.374	2.7	0.417
Chrysene	70	70	400	400	1.1	<0.33	2.6	1.3	<0.33	0.556	5.3	25.1	<4.06	<0.397	<0.388	0.669	0.491	2.92	0.677
Benzo(b)fluoranthene	7	7	40	40	1.6	<0.33	3.9	2	<0.33	<0.388	6.53	29.8	<4.06	<0.397	<0.388	0.474	0.486	2	0.53
Benzo(k)fluoranthene	70	70	400	400	<0.33	<0.33	<0.33	<0.33	<0.33	0.596	4.13	25.7	<4.06	<0.397	<0.388	0.592	<0.374	2.11	0.44
Benzo(a)pyrene	2	2	7	7	0.63	<0.33	1.9	0.78	<0.33	0.41	4.06	27.6	<4.06	<0.397	<0.388	0.495	<0.374	2.24	<0.379
Indeno(1,2,3-cd)pyrene	7	7	40	40	0.53	<0.33	1.1	0.66	<0.33	<0.388	3.65	25.4	<4.06	<0.397	<0.388	<0.379	<0.374	1.31	<0.379
Dibenzo(a,h)anthracene	0.7	0.7	4	4	<0.33	<0.33	0.65	0.34	<0.33	<0.388	<1.98	7.92	<4.06	<0.397	<0.388	<0.379	<0.374	<0.37	<0.379
Benzo(g,h,i)perylene	1,000	1,000	3,000	3,000	0.67	<0.33	1.3	0.78	<0.33	<0.388	3.9	25.5	<4.06	<0.397	<0.388	<0.379	<0.374	1.2	<0.379
VOCs																			
Naphthalene	20	500	20	1,000	NA	NA	NA	NA	NA	<0.388	<1.98	<3.47	<0.406	<0.397	<0.388	<0.379	0.818	0.636	<0.379
Toluene	500	500	1,000	1,000	<0.01	<0.01	<0.02	<0.01	<0.01	<0.18	<0.17	<0.10	<0.14	<0.13	<0.13	<0.17	<0.15	<0.096	0.15
1,1,1-Trichloroethane	500	500	600	1,000	<0.01	<0.01	<0.02	<0.01	<0.01	<0.12	<0.11	<0.067	<0.09	<0.088	<0.088	<0.11	<0.10	<0.064	0.11
Metals																			
Arsenic	20	20	20	20	6.16	12.8	16.3	2.58	9.24	18	13	1.9	18	2.8	13	9.5	16	11	22
Antimony	20	20	30	30	4	<5	50	<6	<10	7.3	<2.7	<2.5	<2.8	<2.8	3	<2.8	<2.6	<2.6	<2.6
Barium	1,000	1,000	3,000	3,000	90	50	160	190	<20	120	65	9.3	76	30	44	52	52	57	73
Beryllium	90	90	200	200	0.094	0.421	0.337	<0.046	0.221	0.92	0.92	<0.25	1.5	0.33	0.43	0.46	0.6	0.67	0.58
Cadmium	70	70	100	100	6.6	4.7	11	8.2	15	<0.56	<0.55	<0.49	<0.56	<0.55	0.84	<0.55	0.62	<0.52	0.94
Chromium (Total)	100	100	200	200	21	44	51	20	170	20	38	7.9	45	9.3	17	20	35	20	36
Lead	200	200	600	600	890	20	330	5	100	160	72	16	19	24	260	130	130	55	160
Mercury	20	20	30	30	0.3003	<0.0751	31.5	0.1934	0.169	0.1	0.4	0.28	<0.097	0.45	0.19	0.59	0.49	0.12	0.34
Nickel	600	600	1,000	1,000	60	30	98	730	140	44	40	6.1	30	34	71	34	39	15	32
Silver	100	100	200	200	<0.94	<1.2	<0.82	<0.94	2.5	<0.52	<0.52	<0.52	<0.52	<0.52	0.6	<0.52	<0.52	<0.52	<0.52
Thallium	8	8	60	60	<10	<10	<20	<10	<20	32	<2.7	6.4	<2.5	15	<2.8	<2.8	<2.6	<2.6	<2.6
Vanadium	400	400	700	700	NA	NA	NA	NA	NA	<2.8	36	<2.5	<2.8	<2.8	23	31	39	35	38
Zinc	1,000	1,000	3,000	3,000	500	52	530	890	310	200	230	23	69	42	360	190	260	100	150

Prepared by B. Hoskins

Values in **bold** exceed applicable MCP Method 1 Soil Standard for S-1/GW-2

NA - Not Analyzed

Additional Non-Detect (ND) analytes not have been included in this table

Table 2. Summary of Historic Groundwater Analytical Results

Elliott Landing
Cummings Center, Beverly, MA

Sample Identification	MCP Method 1 Groundwater Standards		LMB204	LMB204	LMB205	WPB301	WPB302	
	Sample Date Units	GW-2 ug/L	GW-3 ug/L	1/22/88 ug/L	9/19/89 ug/L	1/22/88 ug/L	6/29/88 ug/L	06/30/88 ug/L
TPH								
IR		5,000	5,000	23,000	<2,000	6,500	400	1,800
EPH/PAH								
Naphthalene		700	20,000	<10	<10	<10	<10	21
Phenanthrene		NA	10,000	14	<10	<10	<10	21
Fluoranthene		NA	200	<10	<10	<10	<10	10
Pyrene		NA	20	<10	<10	<10	<10	15
Metals								
Barium		NA	50,000	50	<100	60	<100	<100
Beryllium		NA	200	<1	<20	1	<1.1	<1.1
Copper		NA	NA	<20	<100	<20	10	10
Mercury		NA	20	<0.4	<0.2	<0.2	0.2	<0.2
Nickel		NA	200	11	<400	27	30	<20
Silver		NA	7	<10	<100	50	<20	<20
Thallium		NA	3,000	5	<50	<5	<300	<300
Zinc		NA	900	10	<100	10	40	<10

Prepared by B. Hoskins

Values in **bold** exceed applicable MCP Method 1 Groundwater Standard for GW-2

NA - Not Applicable

Additional Non-Detect (ND) analytes not have been included in this table

Table 3
Data Quality Objectives
Soil Vapor Sampling and Groundwater Sampling
Elliott Landing, 201 Elliott Street, Beverly, MA

1. Problem Statement	<ul style="list-style-type: none">• The primary question to be addressed by this investigation is whether potential volatile contaminant concentrations from vapor intrusion present a significant risk to the indoor air of the occupied building at Elliott Landing. Chemical concentration data are needed to establish if the potential for vapor intrusion is present.
2. Decision Statement	<ul style="list-style-type: none">• Determine an appropriate sampling and analysis design to collect representative data, and describe procedures to implement the sampling program.
3. Inputs to the decision	<ul style="list-style-type: none">• <i>Use of the chemical soil and groundwater historical data:</i> While the overall USM property had a history of usage of VOCs and petroleum compounds, there is no history of such usage at the Elliott Landing parcel and historic sampling reflects a lack of significant presence of these compounds in soil and groundwater. Sampling is designed for the expectation that significant concentrations of compounds will not be detected.
4. Study Boundaries	<ul style="list-style-type: none">• Soil vapor sampling is limited to underneath the newly constructed Elliott Landing building.• One groundwater sampling event (on newly installed wells) is planned to take place in the winter season and one to take place in a different season of the same year during a high groundwater elevation.
5. Decision Rules	<ul style="list-style-type: none">• Soil gas and groundwater data will be evaluated in accordance with the MCP and the MADEP Vapor Intrusion Guidance Policy WSC#-16-435.
6. Limits on Decision Errors	<ul style="list-style-type: none">• Sampling design and laboratory measurement and analysis variability will be monitored by collecting a sufficient amount of quality control/quality assurance samples (i.e., splits, equipment rinsate blanks, duplicates, and matrix spike/matrix spike duplicates).• Level I data validation will be used for validation of the analytical results.• While the goal is to collect samples at the frequency described herein, unforeseen issues may occur that limit the number of samples that can be collected. If encountered, any limitations will be documented.
7. Optimized Design	<ul style="list-style-type: none">• Sampling and Analysis Plan<ul style="list-style-type: none">– The Field Sampling Plan describes the data quality objectives, sampling design for soil gas and groundwater, and field and laboratory methods for confirmation.– The Quality Assurance Parameters are described in the planning document for analytical reporting limits, quality assurance and quality control, and data validation requirements for the confirmation.– Field Sampling Standard Operating Procedures are documented in order to describe field sampling methods consistent with on-site soil sampling procedures.• Provide planning documents to oversight agency for review and comment, address comments, and modify plan, if warranted.